AUTOMATED INFORMATION MANAGEMENT SYSTEM AND METHODS

Reference to Related Applications

[0001] This application claims priority from U.S. patent application Nos. 60/418,478 entitled "AUTOMATED INFORMATION MANAGEMENT SYSTEM AND METHODS" and 60/418,480 entitled "AUTOMATED SYSTEM FOR RANKING INFORMATION BASED ON RELEVANCE", both filed 15 October 2002, both of which are hereby incorporated by reference herein. The subject matter of this application is related to the subject matter of U.S. patent application Nos. 10/260,130 entitled "AUTOMATED SYSTEM AND METHOD FOR DETERMINING THE ACTIVITY FOCUS OF A USER IN A COMPUTERIZED ENVIRONMENT", 10/260,152 entitled "AUTOMATED SYSTEM AMD METHODS FOR COLLECTING DATA", 10/260,173 entitled "AUTOMATED SYSTEM AND METHODS FOR DETERMINING RELATIONSHIPS BETWEEN INFORMATION RESOURCES" and 10/260,587 entitled "AUTOMATED SUPPORT OF USER INTERACTION WITH INFORMATION RESOURCES", all of which were filed on 27 September 2002.

Technical Field

[0002] The invention relates to management of information in computerized environments, and more particularly to systems and methods for determining relationships between information resources, and for determining the relevance of information resources to a user.

Background

[0003] Computer systems can make available to a user a wide variety of information. Information which may be useful to a user may be contained in files of various formats such as word processing documents, spreadsheets, images, audio files, as well as in email

messages or attachments thereto, address books, contact lists, database queries, and other sources, all of which are referred to herein as "information resources". These information resources may be stored in various locations on a computer system.

[0004] To access an information resource, a user generally needs to know where on the computer system the information resource is stored. For example, a user can retrieve a file if the user knows the name of the file and which folder in a directory system the file is stored in. Most currently used operating systems provide search tools for finding files but these search tools can be time consuming and inconvenient to use, especially when the files in question may be stored in any of a wide range of locations. Further, tools for locating files stored in a file system typically cannot search effectively for e-mail messages, contacts, database records, or the like which may not be stored in individual files.

[0005] When a computer user is engaged in a specific task, referred to herein as the user's "current focus", the user may wish to access various information resources. For example, if the user is sending an email, the user may wish to insert information from information resources available on the computer system into the email, or attach information resources as e-mail attachments. The user may also wish to send a copy of the email to another person, or include a copy of a previously received email in the current email. As another example, when the user is working on a file, the user may wish to include in the file data stored in other information resources such as messages or contact information. Such tasks can be tedious and time consuming, particularly when the user is not certain of the locations at which the desired information resources are stored or the user needs to

access several information resources of various types for the current focus.

[0006] Examples of prior art attempts to assist computer users in retrieving information resources include United States Patent No. 4,479,196 to Ferrer et al., United States Patent No. 5,539,665 to Lamming et al., United States Patent No. 5,794,178 to Caid et al., United States Patent No. 5,835,905 to Pirolli et al., United States Patent No. 5,873,107 to Borovoy et al., United States Patent No. 6,236,768 to Rhodes et al. and United States Patent No. 6,256,032 to Hugh.

[0007] There exists a need for systems and methods which facilitate the management of information resources by a user in a computerized environment.

Summary of the Invention

[0008] This invention has various aspects. The invention provides methods and systems for helping users of computer systems gain access to information resources which are relevant to the activity focus of the user.

[0009] One aspect of the invention provides a method for facilitating access to a plurality of information resources in a computerized environment. The method comprises collecting data relating to the plurality of information resources and determining relationships among the plurality of information resources wherein the information resources comprise information resources of a plurality of types; determining a current focus of a user, wherein the current focus is an information resource of one of the plurality of types; identifying information resources related to the current focus, the information resources related to the current focus comprising zero or more

information resources of each of the plurality of types; and, separately making available for selection by the user the identified information resources of each of the plurality of types.

[0010] Another aspect of the invention provides a method for facilitating access to a plurality of information resources in a computerized environment. The information resources may comprise, for example, one or more of messages such as e-mail messages, files, persons (as represented by contact information) or the like. The method comprises: collecting data relating to the plurality of information resources and determining relationships among the plurality of information resources; monitoring activities of a user in the computerized environment to determine a current focus of the user; identifying information resources related to the current focus based on the determined relationships; and, making the identified information resources available for selection by the user.

[0011] In preferred embodiments, making the identified information resources available for selection comprises displaying representations of the identified information resources on a graphical user interface. The identified information resources may be updated to track changes in the current focus.

[0012] In systems and methods according to some specific embodiments of the invention, determining relationships among the plurality of information resources comprises identifying information resources which are messages in a conversation comprising a plurality of messages or are associated with messages in the conversation.

[0013] In systems and methods according to some specific embodiments of the invention, the information resources comprise

information resources of a plurality of types and the current focus is an information resource of one of the plurality of types. In such methods, identifying information resources related to the current focus may comprise identifying at least one information resource of each of the plurality of types; and, making the identified information resources available for selection by the user may comprise separately making available the at least one identified information resource of each of the plurality of types. For example, the system or method may provide the user with access to a set of contact information for people related to the current focus, a set of messages related to the current focus, and a set of files related to the current focus.

[0014] Another aspect of the invention provides a method for locating a plurality of potentially relevant information resources in a computerized environment. The method comprises examining data relating to each one of the plurality information resources; determining relationships between the plurality of information resources based on a comparison of the examined data; and, arranging the plurality of information resources into a plurality of groups, each of the plurality of groups comprising a subset of the plurality of information resources that share at least one common criteria. The at least one common criteria may comprise at least one of lineage, structure, content, function, applied metadata and cross-references.

[0015] Another aspect of the invention provides a computer implemented system for facilitating access to a plurality of information resources in a computerized environment. The system comprises means for collecting data relating to the plurality of information resources and determining relationships among the plurality of information resources wherein the information resources comprise information resources of a plurality of types; means for determining a current focus of a user,

wherein the current focus is an information resource of one of the plurality of types; means for identifying information resources related to the current focus, the information resources related to the current focus comprising zero or more information resources of each of the plurality of types; and, means for separately making available for selection by the user the identified information resources of each of the plurality of types.

[0016] Another aspect of the invention provides a system for determining relationships between information resources in a computerized environment. The system comprises a first component for examining data regarding the information resources; and, a second component for determining explicit relationships between the information resources by examining similarity of data between the information resources.

[0017] Another aspect of the invention provides a system for determining relationships between information resources in a computerized environment. The system comprises a first component for examining data and content regarding the information resources; and a second component for inferring relationships between information resources by comparing indirect data between the information resources.

[0018] Further aspects of the invention and features of specific embodiments of the invention are described below.

Brief Description of the Drawings

[0019] In drawings which illustrate non-limiting embodiments of the invention:

Figure 1 is a schematic representation of a computer system according to one embodiment of the invention;

Figure 2 is a block diagram of an information management system according to a preferred embodiment of the invention;

Figure 3 is a flowchart illustrating a method of organizing information resources according to one embodiment of the invention;

Figure 4A is a schematic representation of relationship data stored in a database according to one embodiment of the invention;

Figure 4B is a schematic representation of relationships between information resources and the conversation of Figure 4A;

Figure 5 is a schematic representation of a contribution map generated by an analytic layer, according to one embodiment of the invention;

Figure 6 is a flowchart illustrating a method of operation of an analytic layer according to one embodiment of the invention;

Figure 7 is a flowchart illustrating the details of one block of Figure 6;

Figure 8 is a flowchart illustrating the details of another block of Figure 6;

Figure 9 is a flowchart illustrating the details of yet another block of Figure 6;

Figure 10 is a schematic representation of a graphic user interface (GUI) display according to one embodiment of the invention;

Figure 11 shows the GUI display of Figure 10 in an expanded condition; and,

Figure 12 is a schematic representation of a GUI display according to another embodiment of the invention.

Description

[0020] Throughout the following description, specific details are set forth in order to provide a more thorough understanding of the

invention. However, the invention may be practiced without these particulars. In other instances, well known elements have not been shown or described in detail to avoid unnecessarily obscuring the invention. Accordingly, the specification and drawings are to be regarded in an illustrative, rather than a restrictive, sense.

[0021] The invention provides methods and systems for assisting a user in locating and retrieving information resources in a computerized environment. Systems according to one embodiment of the invention collect data relating to available information resources and determine relationships among the information resources. Systems according to a preferred embodiment of the invention also rank the available information resources based on their relevance to a user's current focus. The information resources may be presented to the user in a manner which is organized according to their relevance.

[0022] Figure 1 shows a computer system **100** according to one embodiment of the invention. Computer system **100** includes an input device, which comprises a keyboard **104** and mouse **105** in the illustrated embodiment, and an output device, which comprises a monitor **102** in the illustrated embodiment, all connected to a data processor **103**. Data processor **103** is has access to a data store **101**. Data store **101** may comprise any combination of one or more local and/or remote data storage devices which may include disk drives, file servers, resources available by way of other data processors, a local area network, a wide area network, the internet, or other suitable devices.

[0023] Figure 2 illustrates an information management system **200** according to a preferred embodiment of the invention. System **200** runs on computer system **100**. System **200** interacts with applications **202** and

an operating system **204** running on computer system **100**. System **200** provides a user with organized access to information resources **206** (such as files, messages, contacts, etc.) stored in data store **101**. Information resources **206** may include resources within one or more databases, resources within one or more file systems, or both. Information resources **206** are available to computer system **100**.

[0024] System **200** includes a trolling agent **210**, an OS watcher **212**, a database **214**, an analytic layer **216**, and a GUI display **218**. Trolling agent **210** is configured to examine information resources **206** and applications **202** in order to determine relationships among information resources **206**. Trolling agent **210** stores such relationships in database **214**. OS watcher **212** is configured to monitor a user's interactions with operating system **204**. From these interactions, OS watcher **212** determines the user's current focus. OS Watcher **212** may store information specifying the current focus in database **214**, and also provide it directly to analytic layer **216** and GUI display **218**.

[0025] Systems according to some embodiments of the invention permit a user to specify a focus, for example, by directly selecting a specific information resource to be a focus by way of a user interface. A user could use such functionality to set himself or herself as the current focus, thereby causing the system to display information resources most relevant to the user. Systems according to some embodiments of the invention permit a user to control the system to lock the current focus.

[0026] Database **214** is configured to provide information on relationships and focus to both analytic layer **216** and GUI display **218**. Analytic layer **216** identifies available information resources that are related to the current focus. Analytic layer **216** causes representations of those information resources to be displayed on GUI display **218**. In

preferred embodiments, analytic layer **216** filters and sorts the information resources related to the current focus so that the relevant information resources are presented to the user in a way that is ordered based on relevance.

[0027] A user of system **200** is thereby presented on an ongoing basis with a selection of information resources which are relevant to the user's current focus. Information resources not determined to be sufficiently relevant to the current focus are excluded from the selection. The operation of the elements of system **200**, and their interactions with one another and with computer system **100**, are described in more detail below.

[0028] Some embodiments may not filter information resources **206** based on relevance. In such embodiments, GUI display **218** may display a list of all information resources identified in relationships and focus database **214** as being related to the current focus.

[0029] Figure 3 illustrates a method **300** according to one embodiment of the invention. Method **300** begins with installation of system **200** on computer system **100** in block **302**. In block **304** trolling agent **210** examines computer system **100** and collects data relating to information resources **206**. Trolling agent **210** may obtain data relating to information resources **206** from one or more of:

- information resources **206** themselves,
- a file management system (which may be part of operating system **204**), and
- data stored in applications **202**.

Trolling agent **210** uses the information to determine relationships among information resources **206**. Trolling agent **210** stores indications of such relationships in database **214**. Once trolling agent **210** has

collected the data and determined the relationships in step **304**, it may be configured to run in the background of computer system **100**, either continually, periodically, or at the request of the user, in order to update the collected data and determined relationships in response to any changes to information resources **206**. The operation of trolling agent **210** is described further below.

[0030] In block **306**, OS watcher **212** monitors user activity occurring on computer system **100** in order to determine a current focus of the user. The current focus may be determined with regard to the application **202** being used by the user, the information resources **206** being accessed by the user, a history of the user's activity, or the like. Alternatively, the current focus may be input directly by the user. Some ways in which OS watcher **212** can determine the current focus are described below.

[0031] In block **308**, the current focus identified in block **306** and the relationships identified in block **304** are used to identify information resources **206** which are related to the current focus. In block **310**, the information resources identified in block **308** are made available for selection by the user, as described further below.

Determining Relationships - Trolling Agent

[0032] Trolling agent **210** preferably constitutes means for collecting data relating to information resources and means for determining relationships among the information resources.

[0033] Trolling Agent **210** may identify both direct and indirect relationships among information resources **206**. Direct relationships are based on characteristics and content specific to individual ones of

information resources **206**. Indirect relationships may be inferred or deduced based upon observations, assumptions, or knowledge about the information resources being related. Indirect relationships may depend upon chains of observations and are generally more tentative and subject to change based upon the addition of additional observations. Thus, indirect relationships are updated by trolling agent **210** as it operates, and may also be updated by OS watcher **212** as it monitors user activity, or by analytic layer **216** as it determines the relatedness and relevance of information resources **206** to the current focus, as described below. Direct and indirect relationships need not be in a hierarchical form.

[0034] Examples of direct relationships include:

- lineage (parent/child/sibling relationships)
- structural similarity;
- similarity of content;
- similarity of function;
- similarity of applied metadata (time, creator, location, applied subject keywords); and,
- linkage by reference.

[0035] Examples of indirect relationships include:

- similarity of function or use: For example, a user may have more than one contact list or address book, and they may be used with different applications.
- cause and effect: A series of events that appear to be related to each other via cause and effect are linked to each other by indirect relationships, which are based upon our assumptions about the nature of causation.
- relatedness to common focus: As method **300** operates on computer system **100**, various information resources which may not be directly related to each other may be identified as being

related to a common focus. Trolling agent **210** may track some or all of these commonalities to identify new indirect relationships among information resources **206**.

[0036] Figure 4A illustrates an example of the type of relationship data **400** which may be stored in database **214** by trolling agent **210**. Relationship data **400** contains a set of relationship entries **402A-402F**, which represent how information resources, referred to in this context as "targets" are related to a specific information resource, referred to as a "source". In the illustrated example, the source is a conversation, and relationship entries **402A-402F** all relate to that conversation. A conversation is an information resource comprising a group of messages among which trolling agent **210** has inferred a relationship.

[0037] In a preferred embodiment, the member messages of a conversation are identified by examining each email message as it arrives and performing a hashing function on its "Subject" line. The hashed subject line (also referred to as the conversation identity) is stored as an attribute of a new message record in database **214**. The conversation identity is also stored as a new entry in a list of conversations in database **214**. System **200** may assume that messages having similar conversation identities are related to one another. Other methods for identifying messages that should be associated as a conversation may also be used.

[0038] In the example illustrated in Figure 4A, relationship entries **402A-402C** illustrate data derived from a single email message, sent without attachments, from Alice to Bob, Charles and herself. Relationship entries **402D-402F** illustrate the data derived from a single email reply, sent with an attachment "Doc.txt", from Charles to Alice. Figure 4B is a schematic representation of the two messages which form

the subject conversation of Figure 4A. The meaning of the attribute values in the table of Figure 4A are as follows:

- Column **404** lists the source identity, which is the same for all entries **402A-402F** since they all relate to a single conversation;
- Column **406** indicates that the source for the relationships is a "conversation";
- Column **408** contains a unique identifier for each target related to the source (Alice = 1, Bob = 2, Charles = 3, Doc.txt = 4);
- Column **410** contains the names of the targets;
- Column **412** contains the types of the targets;
- Column **414** indicates the type of relationship between the source and the targets; and,
- Columns **416-422** indicate the contributions of each target to the source. In the context of messages, the contributions of each target are preferably normalized for each message. For example, column **418**, which indicates contributions as a receiver of a message, contains the contribution value 0.33 for each of entries **402A-402C**, since Alice, Bob and Charles all received the first message. Contribution values may be used by analytic layer **216** in certain embodiments of the invention, as described below.

[0039] It is to be understood that database **214** can also store other data relating to information resources **206**, such as metadata, content of messages, digests of files or messages, contact information, or other information.

Determining Focus - OS Watcher

[0040] To determine the current focus of the user, OS watcher 212 monitors actions of the user and operating system 204 to determine the user's current focus and usage patterns. OS watcher 212 preferably

constitutes means for determining a current focus of the user. Examples of user actions that may be monitored by OS watcher 212 include:

- keystrokes;
- mouse clicks;
- cursor movements;
- spoken commands;
- function calls;
- error message generation;
- file manipulations such as the creation, modification, deletion, copying, saving or moving of documents or messages;
- the activity status of open application windows in a graphical user interface;
- opening of a file;
- closing of a program;
- moving a window to the "front" in a graphical user interface;
- movement of the cursor to the vicinity of an item;
- in point and click systems, clicking on visual representations of items;
- keystroke sequences corresponding to names or portions of names of specific information resources;
- commands entered by the user;
- exporting files; and,
- saving email attachments.

[0041] It is important to note that the types of user activity that may be monitored in computer system **100** will vary with the configuration of computer system **100**. The user activities and methods of monitoring them listed above are not a comprehensive list.

[0042] In a preferred embodiment of the invention, certain indicators of the user's current focus are chosen as triggers for

information retrieval. The chosen triggers are preferably those that are most like an explicit request from the user to display or retrieve a specific item. Examples of such triggers include: clicking on a file to open or retrieve it, entering or selecting a name of a person or a file from a list, and, dragging and dropping a file into an application window.

[0043] Other indicators of current focus may be less certain, but nevertheless can be profitably logged and analyzed in order to produce additional measures of the relationships between the current focus and information resources **206**. Such indications can be used to produce indicators of probable relatedness with respect to the current focus. An example of such an indicator is concurrently opened documents.

Identifying Information Resources Related to the Current Focus

[0044] In one embodiment of the invention, identification of information resources **206** as being related to the current focus is accomplished by examining database **216** for all information resources **206** having a relationship entry pertaining to the current focus. However, as any computer user will appreciate, the list of information resources **206** on a computer system **100** which may be related to any given focus can be quite large. Presenting a user with such an unstructured list may, in some instances, make it more difficult for the user to locate desired information resources **206**. Accordingly, another embodiment of the invention provides for the filtering and ordering of the identified information resources **206** based on relevance.

[0045] Returning to Figure 2, analytic layer **216** identifies a set of information resources **206** which all have at least some relationship to the current focus. Analytic layer **216** preferably provides information

identifying the resources **206** in the related set to GUI display **218** along with an indication of the number and type of relationship of each information resource on the list to the current focus.

[0046] Analytic layer **216** determines the degree of relatedness of any information resource **206** to the current focus by examining the relationship entries stored in database **214**. As an example, if the current focus is a particular email message, one method of identifying relevant files may include examining all email messages that belong to the same conversation as the message of the current focus. The set of all files attached to any email message in the conversation may be used as a candidate set of related files. By examining the roles that various people played in the conversation one may assess the degree of relevance for each attached file.

[0047] Other relationships in the database that may lead from the message to other candidate files. In one embodiment, the choice of relationships to examine and the methods used to compute relevance are pre-determined. In other embodiments, these aspects may be configurable or may be automatically generated or combined or adapted as the system learns, based on user feedback, which methods produce the desired results.

[0048] Figure 5 illustrates a contribution map **500** generated by an analytic layer **216** according to a preferred embodiment of the invention. Contribution map **500** contains a set of candidate contribution entries **502A-502C**. Contribution Map **500** is preferably a temporary data structure which is deleted by analytic layer **216** when no longer needed. Contribution Map **500** is indexed by candidate identity attributes of entries **502A-502C**, which are stored in column **504** and uniquely identify each candidate. As relationships among information

resources **206** are examined by system **200** in the process of determining relatedness, new relationship entries are created as new candidates are identified.

[0049] The name of each candidate is stored in column **506**. Contributions each candidate has made as a sender, receiver, sender of an attachment, and receiver of an attachment, are stored in columns **508**, **510**, **512** and **514**, respectively. The data stored in columns **508**, **510**, **512** and **514** may be weighted by analytic layer **216**. For example, contribution map **500** shows Alice's contributions as a sender as having a value of 11. This could represent that Alice has sent 11 messages each having a weighting factor of 1, a single message with a weighting factor of 11, or some other combination of number of messages and weighting factors.

[0050] Figure 6 is a flow chart illustrating a method **600** by which analytic layer **216** determines the degree of relatedness of information resources to the current focus according to a preferred embodiment of the invention. Method **600** begins in block **602**, where analytic layer **216** receives the current focus and a list of information resources **206** related to the current focus from database **214**. Method **600** is carried out for each information resource on the list, which are referred to as "candidates".

[0051] In block **604**, analytic layer **216** determines the types of information resources comprising the current focus and the candidate under consideration, which will impact on the method of determining relatedness selected by analytic layer **216**.

[0052] For example, when the focus and candidate types are both of type "person", method **600** proceeds to block **606**. In block **606**,

analytic layer **216** decides between speed and quality. Analytic layer **216** may make this decision based on the number of information resources and relationships that it must examine or on other criteria. When quality (i.e., accuracy and completeness) is preferred, method **600** proceeds to block **608** where it generates raw relevance data, as described further below with reference to Figure 7. When speed is preferred, method **600** proceeds to block **610** where it generates raw relevance data, as described further below. If the focus and candidate types are not both "person", method **600** proceeds to block **612**. In block **612**, analytic layer **216** generates raw relevance data. The raw relevance data may be generated in any of a wide variety of ways. For example, block **612** could employ both the methods of blocks **608** and **610** (and other methods) to generate raw relevance data.

[0053] For each candidate person, a set of contributions attributes such as those shown in columns **508**, **510**, **512** and **514** of Figure 5 is provided for each conversation involving the focus person. Each attribute indicates a raw relatedness value for some aspect of the relationships examined. For example, one attribute may describe the aggregate role that a candidate person played as a sender in a set of conversations with the focus person. In other words, the more times the candidate person sent messages in the conversation involving the focus person, the higher the likelihood that the candidate person is relevant to the focus person.

[0054] Each of the methods in blocks **608**, **610** and **612** provide raw relevance data for the candidates in the list provided to analytic layer **216**.

[0055] The raw relevance data is normalized in blocks **614** to **620**. In block **614**, analytic layer **216** determines which method was used to

obtain the raw relevance data, and selects an appropriate normalization method. Blocks **616**, **618** and **620** represent normalization methods used for raw relevance data generated by the generation methods of blocks **608**, **610** and **612**, respectively.

[0056] The method of block **616** is described further below with reference to Figure 9 as an example of one possible normalization method. The method of block **618** is described further below in conjunction with the method of block **610**.

[0057] Figure 7 illustrates a method **700** employed in block **608** of Figure 6. Method **700** examines the set of all email conversations that involved the focus person and determines from those conversations, the participants (candidates) and their role in each conversation. In block **702**, analytic layer **216** identifies all conversations that were previously stored in database **214**. The conversations related to the focus person are selected by querying database **214** for unique values of Source Noun Id **404** where Source Id Type **406** is "Conversation" and Target Noun Id **408** corresponds to the focus person (see Figure 4).

[0058] In block **704**, analytic layer **216** creates a new, empty contribution map **500** (see Figure 5) to accumulate the raw relevance data in successive steps of method **700**. In block **706**, analytic layer **216** determines the first conversation from the list of stored conversations. In block **708**, analytic layer **216** examines the conversation identity to ensure that the end of the list has not been reached. If there are no more conversations to consider, method **700** ends at block **709**.

[0059] If there is still a conversation to be examined, in block **710** analytic layer **216** generates a list of candidates by examining the list of people referenced by the current conversation (query database **214** for

unique Target Noun Id **408** where Source Noun Id **404** corresponds to the current conversation and Target Noun Type **412** corresponds to "Person"). In block **712**, analytic layer **216** determines the first candidate in the list generated at step **710**. In block **714**, analytic layer **216** examines the candidate to ensure that the end of the list has not been reached. If there are no more candidates to consider, method **700** proceeds to block **716** where analytic layer **216** examines the next conversation in the list and the steps described above are repeated, starting at block **708**.

[0060] If there is still a candidate to be examined, at block **718**, analytic layer **216** determines whether the candidate has an entry in contribution map **500**. If no entry exists, analytic layer **216** creates an entry at step **720**. When an entry exists, at step **722**, analytic layer **216** determines the raw contribution that the current candidate made to the current conversation, as described further below with reference to Figure 8.

[0061] In block **724**, analytic layer **216** determines whether the current candidate is also the focus. If they are not the same person, analytic layer examines the next candidate in the current conversation at block **726**, and the steps described above are repeated for the next candidate in the conversation starting at block **714**.

[0062] If the candidate is also the person in focus, another series of steps is performed that adds the contributions of the focus to the contributions of the candidate. This increases the raw contribution of a candidate when he or she participated in a conversation where the focus contributed. In particular, the degree of focus contribution also directly affects the degree of the participating candidates' overall contribution.

[0063] In blocks **728** and **730**, analytic layer **216** generates a list of candidates in the current conversation, as described above in relation to blocks **710** and **712**. In block **732**, analytic layer **216** determines the candidate name to ensure that the end of the list has not been reached. If there are no more candidates to consider, method **700** proceeds to block **726** and then block **714**.

[0064] If there is still a candidate to be examined, at block **734** analytic layer **216** determines whether the candidate has an entry in contribution map **500**. If no entry exists, analytic layer **216** creates an entry for the candidate in map **500** in block **736**. When an entry exists, analytic layer **216** determines the raw contribution that the focus made to the current conversation at step **738**, using the method of block **722,** which is described below with reference to Figure 8.

[0065] Next, in block **740**, analytic layer **216** determines the next candidate in list and the steps described above are repeated beginning at block **732**.

[0066] Figure 8 illustrates a method **800** carried out by analytic layer **216** in blocks **722** and **738** of Figure 7. In method **800** analytic layer computes the raw contribution of a person (a candidate) to a conversation and adds it to the specified candidate's entry in contribution map **500**. In block **802**, analytic layer **216** identifies a list of relationships between the specified conversation and person. This may be accomplished by querying database **214** for entries where the value of attribute Source Noun Id **404** corresponds to the specified conversation identity and the value of attribute Target Noun Id **408** corresponds to the identity of the contributing person.

[0067] In block **804**, analytic layer **216** considers the first relationship in the list. In block **806**, analytic layer **216** examines the relationship. If there is no relationship to consider, method **800** ends at block **807**. If there is a relationship to consider, analytic layer **216** identifies the set of contribution attributes to consider for the relationship in block **808**. In a preferred embodiment, method **800** considers a predefined set of contribution attributes such as sender, recipient, sender with attachment, recipient with attachment (e.g., columns **416**, **418**, **420** and **422** of relationship data **400**) stored with the relationship. In other embodiments, the contribution attributes used by method **800** may differ for different relationships. In such embodiments, the contribution attributes may be determined by the relationship or its type or otherwise configured.

[0068] In block **810**, analytic layer **216** examines the contribution attributes of the set of contribution attributes identified in block **808**. If block **810** determines that there are no more contribution attributes to consider, analytic layer **216** examines the next relationship in the list in block **812**. Method **800** then processes the next relationship, as described above, beginning at block **806**.

[0069] If block **810** determines that there is one or more contribution attributes to consider then method **800** proceeds to block **814**. In block **814**, analytic layer **216** adds the value of the contribution attribute for the current relationship to the similarly named attribute in the current candidate's entry **502** in contribution map **500**. Method **800** then returns to step **810** and determines whether there are any more contribution attributes to consider for the relationship being processed.

[0070] Figure 9 illustrates a method **900** carried out by analytic layer **216** in block **616** of Figure 6. In method **900**, analytic layer

normalizes each of the raw entries in contribution map **500**. Method **900** derives a scalar value for each candidate's contribution and normalizes the scalar value to be in the range of 0% to 100%. The normalized scalar values for a group of candidates represent the degree of relatedness of each of the candidates to the focus relative to the other candidates. The candidate most related to the current focus is the most (100%) relevant.

[0071] One way to compute the scalar values is to take a weighted sum of all of the raw contribution role values. Different attributes may be weighted differently in the weighted sum to take into account the fact that different attributes have different correlations to the relatedness of a candidate to a conversation (e.g. sending may be a more important indicator of relatedness than receiving; being a named recipient may be a more important indicator of relatedness than being named as a recipient of a cc:). Any form of computation of contribution attributes, weighting values or other information may be used to compute the scalar values.

[0072] In block **902**, analytic layer **216** generates a list of candidates by examining the list of candidates in contribution map **500**. Analytic layer **216** allocates a scalar variable, initially zeroed, for each candidate in the list to hold the combined contribution of that candidate. In block **904**, analytic layer **216** gets the next candidate in the list. If there are no more candidates to process, analytic layer **216** sorts the list of candidate scalar values in block **906** in order of the scalar values. In block **908**, analytic layer **216** finds the largest scalar value in the list and divides each scalar value by the largest scalar value to yield a set of normalized scalar values ranging between 0 and 1. The product of method **900** is a list of candidate identities and their scalar values, which may be supplied to GUI display **218**.

[0073] If, in block **904**, analytic layer **216** determines there is another candidate to consider then method **900** proceeds to block **910** where it selects the entry for that candidate from contribution map **500**. In blocks **912** and **914**, analytic layer **216** determines the set of contribution attributes for the candidate (e.g. analytic layer **216** retrieves values from columns **508**, **510**, **512** and **514** of map **500** in the row corresponding to the candidate). Method **900** then takes the first attribute. Block **916** determines whether there is an attribute to consider. If there is no attribute to consider method **900** proceeds to block **918** to process the next candidate in the list as described above beginning at block **904**.

[0074] If block **916** determines that there is an attribute to consider, analytic layer **216** obtains the attribute value corresponding to the current candidate from contribution map **500** in block **920**. In block **922**, analytic layer **216** obtains a role contribution weighting value, corresponding to the contribution attribute, and multiples the candidate's contribution value by the weighting value. The weighting value may be pre-determined or configurable.

[0075] In block **924**, analytic layer **216** adds the resulting value, to the scalar variable allocated to the candidate. In block **926**, analytic layer **216** considers the next candidate in the list and proceeds to process the next candidate in the list as described above, beginning at block **916**.

[0076] Method **600** of Figure 6 contemplates that alternative methods for computing relevance may be carried out in blocks **610** and **618**. Blocks **610** and **618** produce relevance measures with less computation than blocks **608** and **616** which are described above. For

example, block **610** may compute raw relevance in two steps. The first step identifies contributions by candidates that sent messages to the focus person. The second step identifies contributions by the focus person in sending messages to the candidate.

[0077] For each step, the contributions from each candidate are normalized by dividing it by the largest contributor. The normalized contributions for each candidate of the first and second steps are computed and normalized in block **618** to a scalar according to an equation such as:

(Contribution as Sender to Focus + (*W* × Contribution as Receiver from Focus)) / (1+ *W*) (1)

Where *W* is a coefficient that expresses the relative importance of being a sender of messages in a conversation and being a receiver of messages in the conversation to the relatedness between the candidate and the conversation. Thus, if a candidate has sent many messages to the focus, but has not received any messages from the focus, that candidate's relevance is reduced. In some embodiments, *W* is set to 2. Different relationships, characterizing the relationship of people to messages may be used to derive equations which may be used in place of equation (1).

[0078] The methods described above are example methods used by analytic layer **216** to determine the relevance of information resources **206** to the current focus when both the resources and the focus are people. For any combination of a focus and candidate, there may be many methods to compute the relevance. Different methods will have different advantages and disadvantages. The following paragraphs outline example approaches for other combinations of information resource types to further illustrate preferred embodiments of the invention.

[0079] ***Message - Person Methods:*** Where the current focus is a message, an example method for identifying people who are most relevant to the message is similar to the method shown in Figures 7 to 9. In this case, however, analytic layer **216** selects a conversation by querying the message entity record to obtain the conversation identity.

[0080] ***Message - File Methods:*** Where the current focus is a message, an example method for identifying files most relevant to the message starts by finding the conversation to which that message belongs. The method then identifies all files attached to all messages in the conversation. This may be accomplished by first selecting all of the entries from database **214** where Source Noun Id **404** corresponds to the conversation. Then, the selected entries are queried to find the files identified by Target Noun Name **410** where Target Noun Type **412** is "File".

[0081] In a preferred embodiment, the list of all files in the computer system **100** is also searched by name for files having names similar to any of the files attached to messages in the conversation. The method then proceeds to compute a measure of relevance for each file.

[0082] The relevance measures are higher for files related by attachment than for files related by similar names. The relevance measures for files related by similar names may be based upon a degree to which the files names are similar to the name of an attached file. All the relevance measures may also be scaled based on how far in the past the file was modified. More recently modified files may be given higher relevance measures than files which have not been modified for a long time.

[0083] ***Message - Message Methods:*** Where the current focus is a message, an example method for finding relevant messages uses two factors in determining relevance. A set of candidate messages is the messages in the same conversation as the focus message. A first factor which may be used to generate a relevance measure for the candidate messages is based on time. The contribution of a message decreases with its age. The most recent messages have higher contributions. Older messages have smaller contributions.

[0084] A second factor is the relevance of the message sender to the user, in the context of the message-referenced conversation (e.g. similar to Person-Person but within the scope of a single conversation).

[0085] ***File - Person Methods:*** Where the current focus is a file, an example method for finding relevant people is similar to that shown in Figures 7 to 9. In this case, however, the conversations selected by analytic layer in block **702** may be determined by querying database **214** for unique values of Source Noun Id **404** where Source Id Type **406** is "Conversation" and Target Noun Id **408** corresponds to the file in focus.

[0086] ***File - File Methods:*** Where the current focus is a file, an example method for finding relevant files begins by finding the conversations where the focus file was an attachment. The method continues by finding other attached files in those conversations. In one preferred embodiment, each found file in the list is matched against all other known files in the computer system 100 in a search for files with similar names. A relevance measure is then determined for each candidate file. The relevance measure is higher for candidate files related by attachment than it is for candidate files which merely have names similar to those of attached files. A file related by similar name is

given a relevance measure proportionate to the degree to which the name is similar to an attached file.

[0087] All of the relevance measures may be scaled based on how far in the past the candidate file was modified and/or sent.

[0088] ***File - Message Methods:*** Where the current focus is a file, an example method for finding relevant messages builds a list of candidate messages by taking all messages in any conversations in which the focus file was an attachment. Two factors may be used in determining the relevance of candidate messages. A first factor is based upon time. The contribution of a message decreases with its age. The most recent messages have higher contributions. Older messages have lower contributions. A second factor is the relevance of the message sender to the user, in the context of all the file-referenced conversations.

[0089] ***Person - File Methods:*** Where the current focus is a person, an example method for finding files starts by finding all of the conversations the focus person has participated in. A list of candidate files can be built by taking all of the files referenced by attachment in all of the messages contained in all of those conversations. In one preferred embodiment, each candidate file in the list is matched against all other known files in system **100** to find additional candidate files with names similar to the files.

[0090] A relevance measure is then determined for each candidate file. Within the group of files related by attachment, files in a first group of files attached to messages sent by the person in the focus field are given highest relevance. Other files related by attachment to messages in the conversation are given lower relevance. Files related by similar name are given relevance proportionate to the degree to which their names are

similar to the name of an attached file. All of the relevance scores may be scaled based on how far in the past the file in question was modified.

[0091] ***Person - Message Methods:*** Where the current focus is a person, an example method for finding messages starts by finding all of the conversations in which the focus person participated. Of the messages in the conversation, the ones sent by the focus person to only one recipient are given the highest relevance. Next highest are messages from the focus person to a group of persons. Next highest are messages sent by others. These three categories of messages may optionally be presented to the user as three separate groups. All the relevance scores may be scaled based on how far in the past the message was sent.

Making Information Resources Available - GUI Display

[0092] In a preferred embodiment, information management system **200** is used in a computer system **100** with a monitor **102**, which displays GUI display **218** to the user. GUI display **218** preferably constitutes a means for making information resources related to the current focus available for selection by the user.

[0093] Figure 10 depicts a screen **1000** of monitor **102** displaying a first display mode of GUI display **218** according to one embodiment of the invention. An application window **1002** being used by the user is displayed on screen **1000**. When in its first display mode, GUI display **218** comprises a status bar **1004** at an edge of screen **1000**. Status bar **1004** displays icons **1006** for various categories of information resources, as well as quantity indicators **1008**, which represent the number of information resources or each category identified as related to the current focus. Status bar **1004** occupies a small amount of area on

screen **1000** and provides an unobtrusive cue to the user about the amount of information resources related to the current focus.

[0094] In the Figure 10 embodiment, icons **1006A-1006C** represent messages, files, and people, respectively, and indicators **1008A-1008C** represent the number of identified information resources **206** in these categories. The invention is not limited to these categories.

[0095] When a user wishes to explore the information resources **206** related to the current focus the user may use mouse **105** to point at the status bar **1004**. This causes GUI display **218** to expand to display legend **1100**, as shown in Figure 11. Legend **1100** provides an expanded view of the information resources **206** related to the current focus, which is preferably displayed in field **1102**. Optionally, the user is able to manually alter the current focus by means of a drop down menu in field **1102**, or may lock the current focus to the focus displayed in field **1102**.

[0096] Legend **1100** comprises a message pane **1104**, a file pane **1106** and a people pane **1108**. Each pane **1104**, **1106**, **1108** comprises a list of information resources **206** of the same type along with additional attributes of each information resource. As an example, person pane **1108** contains three relevant people, **1108A-1108C**. For each person **1108A-1108C**, relevance symbol **1110**, linkage symbol **1112**, name **1114**, and address **1116** are displayed to indicate attributes of the people.

[0097] Relevance symbol **1110** preferably comprises a horizontal bar whose fill level indicates the degree of relatedness of the person identified by name **1114**, and is generated by analytic layer **216**. The entries in the person pane **1108** are sorted by one of the attributes **1110**, **1112**, **1114** or **1116.** In the Figure 11 example, relevance **1110** is the sorting attribute. The user may use the mouse **105** to change the sorting

attribute and may also launch an application associated with the entry by clicking on linkage symbol **1112** (for example launching a new message to the selected person). The other panes **1104** and **1106** contain similar information corresponding to messages and files, respectively.

[0098] Figure 12 depicts a GUI display **218** according to another embodiment of the invention. In the Figure 12 embodiment, GUI display **218** comprises a portal **1200** enclosed within a window on monitor **102**. Portal **1200** comprises a title pane **1202**, a views pane **1204**, and an information pane **1206**. Title pane **1202** includes a focus input field **1208** and search button **1210**. The user may select a focus by entering a partial text string in focus input field **1208** and selecting search button **1210**.

[0099] Views pane **1204** indicates a list of view selection symbols. The user may use mouse **105** to select one of the symbols in views pane **1204**, which causes portal **1200** to present an alternate information pane **1206** corresponding to the selected view.

[0100] Information pane **1206** comprises a current focus symbol **1212**, a people pane **1214**, a messages pane **1216**, and a files pane **1218**. Other information panes **1206**, corresponding to different views, may have a different organizational structure. However, the concepts described for the illustrated view apply to the other views as well, the other view need not be described.

[0101] People pane **1214** comprises a my contributors pane **1220** and a recent contributors pane **1222**. Both my contributors pane **1220** and recent contributors pane **1222** include a list of related people generated by analytic layer **216**. My contributors pane **1220** preferably displays a list which has been filtered and sorted by analytic layer **216** to include only the most relevant people over a significant period of time,

listed in order of their degree of relevance. Recent contributors pane **1222** preferably displays a list which has been filtered and sorted by analytic layer **216** to include only the most relevant people over a recent period of time, listed in order of their degree of relevance.

[0102] Messages pane **1216** comprises a from my contributors pane **1224** and an only to me pane **1226**, both of which include a list of related messages generated by analytic layer **216**. From my contributors pane **1224** preferably displays a list which has been filtered and sorted by analytic layer **216** to include only those involving the participation of people listed in my contributors pane **1220** and having a high degree of relevance. Only to me pane **1226** preferably displays a list which has been filtered and sorted by analytic layer **216** to include those that were sent only to the person identified in current focus symbol **1212** and having a high degree of relevance.

[0103] Files pane **1218** comprises a recent attachments pane **1228** and a recent files pane **1230**, both of which include a list of related files generated by analytic layer **216**. Recent attachments pane **1228** preferably displays a list which has been filtered and sorted by analytic layer **216** to include only those having been sent or received as attachments within a recent period and having a high degree of relevance. Recent files pane **1230** preferably displays a list which has been filtered and sorted by analytic layer **216** to include only those files which have recently been modified and having a high degree of relevance.

[0104] GUI display **218**, in one preferred embodiment of the invention, allows the user to add or sever relationships with a focus. As an example, the relevance of people listed in my contributors pane **1220** may be initially computed using the methods described above. GUI

display **218** provides a method for the user to explicitly exclude people from or add people to my contributors pane **1220**. This new data may then be used in additional steps of the methods of analytic layer **216** or may be used to augment and/or filter information in GUI display **218**. It is understood that other methods, including but not limited to, altering the stored records of entities and relationships in database **214** may be supported by GUI display **218** so that analytic layer **216** produces the results desired by the user.

[0105] In addition to being able to change the current focus using the focus input field **1208**, the user can change the current focus by selecting any of the people, messages, or files displayed in any of panes **1214**, **1216** or **1218**.

[0106] Portal **1200** is configured to operate in the context of a web browser and thus has the advantage of a familiar interaction paradigm. It also has the advantage of providing a variety of views of relatedness among information resources **206** based on different methods of computing the relatedness. It also has the advantage of being able to use the information from one view to sort and filter information in another view (e.g. presenting messages filtered by historically or recently important people). Portal **1200** also has the advantage of being able to launch a native application associated with a displayed information resource. This ensures that the user's focus on related information resources is not lost while using the launched application.

[0107] Other types of user input and output means may be used as well. It is also understood that presentation of other information resource attributes and types in GUI Display **218** is within the scope of the invention. It is also understood that different methods of organizing (e.g. filtering, sorting, displaying) the information resource presentation is

within the scope of the invention It is also understood that entities other than a user (e.g. a computerized system or application) may interact with system **200** to establish a current focus and obtain relevant information resource information.

[0108] Certain implementations of the invention comprise computer processors which execute software instructions which cause the processors to perform a method of the invention. The invention may also be provided in the form of a program product. The program product may comprise any medium which carries a set of computer-readable signals comprising instructions which, when executed by a computer processor, cause the data processor to provide a system according to the invention or to execute a method of the invention. The program product may be in any of a wide variety of forms. The program product may comprise, for example, physical media such as magnetic data storage media including floppy diskettes, hard disk drives, optical data storage media including CD ROMs, DVDs, electronic data storage media including ROMs, flash RAM, or the like or transmission-type media such as digital or analog communication links. Software instructions on the program product may be stored in an encrypted and/or compressed format.

[0109] Where a component (e.g. a software module, processor, assembly, device, circuit, etc.) is referred to herein, unless otherwise indicated, reference to that component (including a reference to a "means") should be interpreted as including as equivalents of that component any component which performs the function of the described component (i.e., that is functionally equivalent), including components which are not structurally equivalent to the disclosed structure which performs the function in the illustrated exemplary embodiments of the invention.

[0110] As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.